934 The Surface ECG at Rest and in Exercise

Monday, March 17, 1997, Noon–2:00 p.m.
Anaheim Convention Center, Hall E
Presentation Hour: 1:00 p.m.–2:00 p.m.

934-51 Lot Quality Assurance Sampling for Determining ECG Laboratory Performance

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Examinations to assess individual ECG interpretive skill, such as the ACC ECGEXAM, do not evaluate the overall operation of an ECG laboratory because actual reader performance and variability are not measured. Large volume ECG labs are difficult to evaluate due to multiple readers and a review of every ECG interpretation is impractical. A scientifically valid sampling methodology is required. Lot quality assurance sampling (LQAS) provides information about batch quality using an efficient sample and testing with binomial probability. We have designed and implemented a quality improvement instrument for a large EGG laboratory (30 readers, 45,000 ECGs/yr.) to generate a stratified random sample of ECGs monthly based on LQAS requirements. All ECGs are read primarily by a computer program, overread by a cardiologist and finally reanalyzed by a blinded overreader. A modified Minnesota coding system provides a standard.

Results: Errors in ECG interpretation for the lab overall ranged, monthly, from 15–35%. Significant variation in error rates were identified among the individual readers (0–70%, $p < 0.03$), related principally to the proportion of ECGs interpreted originally by the computer program as abnormal. No relation between the proportion misread and the absolute number of ECGs interpreted nor seniority in the roster could be established. The most frequent errors related to diagnosis of a myocardial infarction (10%), ST abnormalities (8%) and left ventricular hypertrophy (6%).

Conclusions: Sampling techniques are available which allow for a pragmatic evaluation of ECG laboratory performance and identify "acceptable" levels of reader performance in an ongoing fashion.

934-52 Time-Voltage Area of the QRS Complex: Improved Accuracy of the 12-Lead Electrocardiogram for Left Ventricular Hypertrophy

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Identification of left ventricular hypertrophy (LVH) using 12-lead ECG criteria based primarily on QRS amplitudes has been limited by poor sensitivity at acceptable levels of specificity. Although the product of QRS voltage and duration, as an approximation of the time-voltage area of the QRS complex, can improve accuracy of the 12-lead ECG for LVH, the value of true time-voltage area measurements from the standard 12-lead ECG has not been examined. Therefore, the additional diagnostic value of time-voltage area measurements of the QRS for the recognition of LVH was evaluated in 249 patients who had digital 12-lead ECGs and echocardiograms. Standard voltage criteria, voltage-duration products (voltage × QRS duration), and time-voltage areas were calculated for Sokolow-Lyon criteria ($SV_1 + RV_{5/6}$) and for the 12-lead sum of voltage criteria. Sensitivities were calculated in the 74 patients with LVH using gender-specific partitions with matched specificity of 98% in the 175 patients without LVH (*$p < 0.05$, **$p < 0.001$ vs respective time-voltage area):

Criteria	Voltage	Voltage-Duration Product	Time-Voltage Area
Sokolow-Lyon	43%**	54%*	65%
12-lead sum	46%**	54%**	76%

Comparison of receiver operating characteristic curves confirmed the superior overall performance of time-voltage area criteria. These preliminary results suggest that use of time-voltage areas can dramatically improve identification of LVH by the 12-lead ECG.

934-53 Parietal Block Superimposed on Right Bundle Branch Block: A New ECG Marker of Right Ventricular Dysplasia

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Previous studies had demonstrated that right ventricular dysplasia (RVD) shows a definite prolongation of QRS complex duration in leads V1, V2 or V3 as compared with leads I or V6 as a result of a parietal conduction delay. Value of this sign in RVD cases with a complete right bundle branch block (RBBB) pattern is the purpose of this study.

A complete RBBB was present in 11 of a series of 97 ascertained RVD patients. QRS complex duration was compared with a control group of 6 airline pilots (matched in age and sex) with complete RBBB and otherwise normal heart. Measurements were made with a caliper on amplified ECG tracings. D expressed the largest difference in QRS complex duration between leads V1, V2 or V3 and lead V6.

D was significantly higher in the RVD group ($D = 52 \pm 36$ ms, range 0 to 120 ms), than in the control group ($D = 7 \pm 10$ ms, range 0 to 20 ms; $p = 0.01$). Histogram of D in RVD group showed two significantly different subgroup ($p < 0.001$): Subgroup A of 4 cases with $D = 12.5 \pm 9.5$ ms (0 to 20 ms) and subgroup B of 7 cases with $D = 74 \pm 23$ ms (ranging from 50 to 120 ms). This suggests that some patients with RVD have a parietal conduction delay *in addition* to a complete RBBB. The term of ≪ more than complete right bundle branch block ≫ may be used to describe this condition.

Conclusion: In cases with complete RBBB, a difference equal to or more than 50 ms between the largest QRS duration in right precordial leads and V6 may be a new simple marker of RVD and some other right ventricular cardiomyopathies.

934-54 Body Surface Mapping of Repolarization Potentials in Patients with Arrhythmogenic Right Ventricular Dysplasia. Principal Component Analysis of the ST-T Waves

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Abnormalities of ventricular repolarization are frequently observed in arrhythmogenic right ventricular dysplasia (ARVD), but their predictive value for malignant arrhythmias is yet to be established.

In order to find abnormalities which can be predictive of ventricular arrhythmias, body surface potential maps were recorded from 62 anterior and posterior thoracic leads in 19 patients affected by ARVD, 9 with episodes of sustained ventricular tachycardias (VT) and 10 without, 14 males, 5 females, mean age 40 ± 14 years. 30 healthy subjects were also studied as controls. The 62 chest ECG were simultaneously recorded, digitally converted at a rate of 2000 Hz, and stored on hard disk of a 80486 computer. The ST-T waves were divided into successive 20 msec intervals and the mean potential value of each interval was considered. Thus, ST-T waves are represented by a discrete series of 15–20 values. In each subject we performed the principal component analysis of the 62 ST-T waves recorded. We assumed that a low value of the first or of the first three components (Co 1, 2, 3), corresponding to a relatively high information content of the remaining Co, indicates a greater than normal variety of the ST-T waves, a likely expression of a more complex recovery process. The mean values of the first 3 Co were not significantly different in ARVD patients and in control subjects. Nevertheless, considering the two subsets of patients with and without VT, significantly lower values were found in the group of ARVD patients with VT, as shown below.

	Pts. n	Co 1	Co 2	Co 1 + 2	Co 1 + 2 + 3
TV +	9	64.4 ± 10.6	21.2 ± 12.9	83.4 ± 11.9	89.9 ± 8.4%
TV −	10	80.4 ± 5.8	12.5 ± 2.5	92.2 ± 4.2	97.2 ± 2.5%
p		*0.0007*	*0.008*	*0.043*	*0.015*

Specifically, values of Co 1 < 68% (equal to 1 SD below the mean value for controls) were found in 6 of 9 VT pts (67%), but in no pt without VT ($p < 0.005$) In conclusion, these results suggest that principal component analysis of the ST-T waves recorded from the entire chest surface reveal abnormalities, which can be considered indices of arrhythmia vulnerability.

934-55 Cardiac Dysfunction and Outcome in Patients with Subarachnoid Hemorrhage and Electrocardiographic Abnormalities

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Background: The majority of patients with subarachnoid hemorrhage (SAH) have ECG abnormalities and approximately 25% of these patients have changes consistent with ischemia or infarction (MI). Case reports have suggested that cardiac outcome is favorable in these patients but no larger study has addressed this issue. Our aim was to identify a series of SAH patients with ECG changes consistent with ischemia or MI and determine their cardiac outcome - measured by clinical and radiographic evidence of pulmonary edema, CPK-MB elevations, arrhythmias, and cardiac death.

Methods: Of 111 adult patients with SAH admitted to our hospital over a two year period, 84 had available ECGs. Of these 84 patients, 24 had ECGs consistent with ischemia or MI. 22 of these patients had available medical